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ABSTRACT

Recent trends concerning the employment opportunities for doctorate-holding scientists and engineers (S/E) are highlighted in this publication. Data from biennial surveys conducted since 1973 by the National Science Foundation and other Federal government agencies are analyzed to make conclusions regarding trends in labor-market conditions, sectorial shifts, research and development employment, fields of most rapid growth in employment, and the number and proportion of women and minorities in doctorate-holding S/E positions. (CS)

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SCIENCE RESOURCES STUDIES HIGHLIGHTS

NATIONAL SCIENCE FOUNDATION WASHINGTON, D.C. 20550 JULY 24, 1981 NSF 81-312

Employment Opportunities for Ph.D. Scientists and Engineers Shift From Academia to Industry

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Surveys of doctorate-holding scientists and engineers[1] have been conducted biennially for the National Science Foundation (NSF) and other Federal Government agencies by the National Research Council of the National Academy of Sciences since 1973. The science and engineering (S/E) population surveyed consisted of individuals in the United States who held S/E doctorates or who had received doctorates in non-S/E fields but were employed in S/E positions. The 1973 survey included individuals who had received their doctorates in the 42-year period between January 1, 1930, and June 30, 1972. Subsequent surveys in this biennial series continued to take account of a 42-year period by dropping the two oldest cohort years and adding the two most recent.

Highlights

- Job opportunities in science and engineering (S/E) activities continued to grow between 1977 and 1979, but at a slightly slower pace than in the early seventies. Employment of Ph.D. scientists and engineers in S/E activities (S/E employment), at 287,100 in 1979, increased at an average annual rate of 5 percent per year between 1977 and 1979, down from an average annual increase of 8 percent between 1973 and 1975.

- When compared to the growth in available supply, S/E job opportunities for Ph.D.'s barely kept pace. Although practically all (99 percent) Ph.D. scientists and engineers seeking work find employment, an increasing but small share (6.4 percent in 1973 and 8.5 percent in 1979) of those employed have been working in jobs outside their own or related S/E field. Most of those working outside of science or engineering are doing so voluntarily. Only about 10 percent of them indicated that they were in non-S/E jobs because S/E positions were not available.

- The average annual growth rate in Ph.D. S/E employment between 1973 and 1979 was more than double that of scientists and engineers at all degree levels (6 percent vs. 2.5 percent).

- There was a softening in S/E employment demand in some fields—particularly mathematical and social sciences, fields in which the S/E utilization rate (i.e., S/E employment per 100 Ph.D. scientists and engineers in the labor force) declined 4 to 5 percentage points. S/E job opportunities for Ph.D. engineers and computer and environmental scientists remained strong.

- Although employment of doctoral scientists and engineers in S/E jobs continued to grow, job opportunities shifted away from educational institutions to business/industry. This sectoral shift represents a continuation of longer term changes and reflects demographic trends which are reducing the rate of growth of the population in the age-groups that are likely to enroll in higher education institutions. The shift has important implications for the nature of doctoral work activities. For example, the slow growth in academic employment produced, in part, a shift in work activities from teaching to research and development and other work activities across all sectors.

- There was a substantial shift in business/industry R&D employment from research into development/design. Within business/industry, the number of doctorates primarily engaged in basic and applied research grew at average annual rates of 5 percent and 1 percent, respectively, between 1973 and 1979, while employment in development/design activities increased at an annual rate of 9 percent.

[1] The 1977 and 1979 surveys were expanded to include doctorate-holders in the humanities in the United States.

(Prepared in the Demographic Studies Group, Division of Science Resources Studies)

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- Changes in employment patterns between 1973 and 1979 revealed a shift away from physical and mathematical sciences toward computer and social sciences and psychology.
- The share of minority S/E Ph.D.'s rose from 5 percent to 8 percent of the total Ph.D. S/E population between 1973 and 1979. Blacks, however, remained at 1 percent during this period.
- The share of women Ph.D. scientists and engineers increased from 9 percent to 11 percent during this 6-year period.
- Salary differentials between men and women Ph.D. scientists and engineers grew from 20 percent to 29 percent between 1973 and 1979, mostly because recent women S/E doctorate recipients have tended to enter the Ph.D. labor force in the lower paying fields, e.g., life and social sciences and psychology. Within fields, there are smaller differences in 1979 pay between men and women among recent Ph.D. recipients than among older Ph.D. scientists and engineers, among whom the differences continue to be substantial.

Labor-Market Conditions

S/E job opportunities at the Ph.D. level continued to grow (5 percent per year between 1977 and 1979), but at a slower pace than in the early seventies (8 percent per year between 1973 and 1975). When compared to the growth in the supply of S/E doctorates, however, growth in S/E job opportunities either barely kept pace or fell slightly behind. Although practically all (99 percent) Ph.D. scientists and engineers seeking work find employment, an increasing share have been working in jobs outside their own or related fields, as shown by the "S/E utilization rate." This rate shows the percentage of Ph.D. scientists and engineers in the labor force who hold S/E jobs[2] and reflects both general labor-market conditions and whether those with training in science or engineering utilize their training in S/E jobs.

The 1979 utilization rate for S/E Ph.D.'s indicates that S/E job opportunities remain strong overall when compared to available supply with some exception for social and mathematical scientists. The overall S/E utilization rate for Ph.D. scientists and engineers declined two percentage points between 1973 and 1979 (92.5 percent to 90.7 percent), with declines of four to five points noted for mathematical and social scientists. Social scientists showed the lowest rates for both 1973 and 1979 and registered the largest decline over this period.

As measured by S/E utilization rates, women fared better than men between 1973 and 1979. Whereas the utilization rate for men did not increase in any field, utilization rates for women increased in engineering and the physical, environmental, and life sciences.

Sectoral Shifts

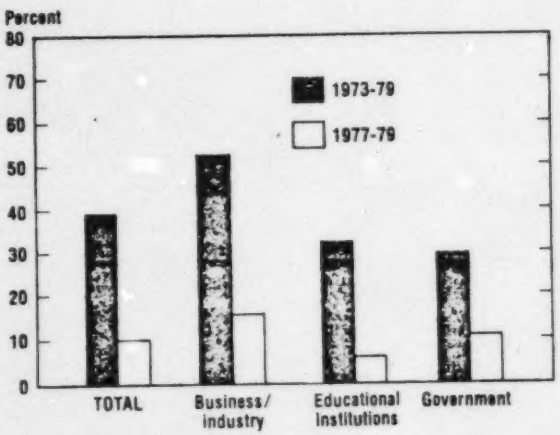
Opportunities for Ph.D.'s in S/E employment appear to be shifting away from educational institutions to business/industry, where S/E employment of doctoral scientists and engineers grew 16 percent between 1977 and 1979, about two and one-half times the rate for educational institutions (chart 1).[3]

The recent shift of employment opportunities away from educational institutions also represents a continuation of longer term trends. S/E employment of Ph.D.'s in educational institutions grew by about one-third between 1973 and 1979 and by over one-half in business/industry. Based on demographic patterns and their effects on enrollments, the rate of S/E Ph.D. employment growth in educational institutions is likely to decline in the future. Population growth in the age groups that are most likely to enroll in college has been increasing at slower rates than in the past and is ex-

[2] The labor force includes those employed in any job and those seeking employment. The S/E utilization rate is computed by dividing the number of Ph.D.'s employed in science or engineering by the number in the doctoral S/E labor force.

[3] Comparable shifts have also been occurring for all employed (i.e., in both S/E and non-S/E positions) Ph.D. scientists and engineers.

Chart 1. Percent increase in number of science/engineering-employed Ph.D.'s in selected sectors of the economy



SOURCE: National Science Foundation

pected to decline for the better part of the eighties.[4] Whether the relative redistribution of employment to business/industry will continue depends largely on the future growth of economic activity and R&D spending in both the industrial and the academic sector.

R&D Employment

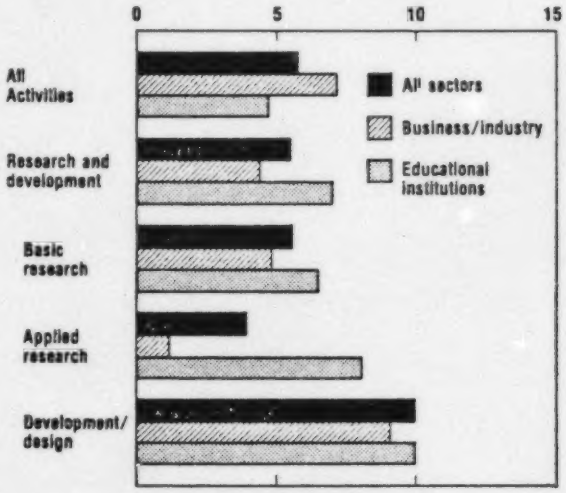
Across all sectors, research and development[5] replaced teaching as the largest work activity in S/E employment in 1979—97,000 vs. 86,000 individuals—primarily because of the slow growth in teaching opportunities. Although the number primarily engaged in basic and applied research increased between 1973 and 1979 (up 33 percent to 82,000), the number engaged in development/design increased more rapidly (up 77 percent to 14,500). These differential trends in work activity among R&D components are in part attributable to the sectoral shifts discussed earlier. Academia, the slow-growth sector, performs the major share of basic research.[6] Business/industry, the rapid-growth sector, performs the major share of applied research and development/design.[7] Despite the fact that total S/E employment grew more rapidly in business/industry than in educational institutions, growth in the number of S/E doctorates engaged in research and development was less rapid in business/industry.

Within-sector shifts in R&D activities also occurred among educational institutions and business/industry—the major employment sectors for Ph.D. scientists and engineers. There was a general shift from research to development/design in each sector (chart 2). Within research, there was a shift away from applied research in business/industry and a slight move away from basic research in academia—both toward development/design.

Field

The 1977-79 growth rates in S/E employment show a shift in utilization patterns away from physical and mathematical sciences (table 1). These short-term shifts are the most recent indicators of more fundamental long-term trends, which show S/E employment growth

Chart 2. Average annual rate of growth of science/engineering-employed Ph.D.'s in R&D activities by selected sector of employment: 1973-79



SOURCE: National Science Foundation

Table 1. Selected characteristics of doctoral scientists and engineers in the United States: 1973, 1977, and 1979

Characteristics	1973 number	1977 number	1979 number	Percent change 1977-79	Percent change 1973-79
Total population	238,900	303,300	332,300	10	39
Male	218,000	271,600	294,400	8	35
Female	20,900	31,700	37,900	20	82
White	217,100	270,600	293,500	8	35
Black	2,200	2,900	3,700	29	68
American Indian	400	700	1,000	46	122
Asian	9,600	15,800	21,700	37	126
No report	9,500	13,400	12,400	−7	31
Total S/E employment	206,200	261,100	287,100	10	39
Physical sciences	44,200	51,300	54,400	6	23
Mathematical sciences	11,700	13,600	14,100	4	20
Computer sciences	2,700	5,700	6,600	16	146
Environmental sciences	10,100	12,600	14,100	12	40
Engineering	34,200	42,400	47,100	11	38
Life sciences	55,600	68,100	76,000	12	37
Psychology	23,400	31,300	35,000	12	50
Social sciences	24,400	36,000	39,800	10	63

SOURCE: National Science Foundation

[4] This subject has been treated in detail in *Research Excellence through the Year 2000*, Commission on Human Resources, National Academy of Sciences, 1979. A recent NSF study suggests, however, that this future trend may not present as serious a set of problems for the major research universities as it will for other educational institutions. See National Science Foundation, *Employment Patterns of Academic Scientists and Engineers, 1973-78* (NSF 80-314) (Washington, D.C.: Supt. of Documents, U.S. Government Printing Office, 1980).

[5] Research and development is defined in this *Highlights* to exclude management/administration of research and development.

[6] In 1973, almost two-thirds of the Ph.D. scientists and engineers primarily engaged in basic research were employed in educational institutions.

[7] In 1973, 54 percent of the Ph.D. scientists and engineers primarily engaged in applied research and development were employed in business/industry.

rates for 1973-79 to be most rapid in computer sciences, psychology, and social sciences, and slowest in the physical and mathematical sciences. The largest absolute growth in employment took place among life scientists (up 20,400 to 76,000).

Women and Minorities

The number and proportion of women Ph.D. scientists and engineers continued their rapid growth between 1977 and 1979 (table 1). The average annual rate of increase for these women was 10 percent between 1973 and 1979, more than twice that of the men. Women as a proportion of total Ph.D. scientists and engineers increased from 9 percent to 11 percent during this period.

The number of minority Ph.D. scientists and engineers in the population increased rapidly (37 percent) between 1977 and 1979 (table 1). Over the longer period, 1973-79, this population more than doubled, representing a growth rate three times that for nonminorities.

Proportionately, minority Ph.D. scientists and engineers rose from 5 percent to 8 percent of the total between 1973 and 1979, with the largest gains among Asians, who comprise 80 percent of minority S/E Ph.D.s. Blacks, however, remained at only 1 percent of all Ph.D. scientists and engineers.

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